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STUDIES ON GROWTH AND SEED PRODUCTION PATTERN IN BILLY GOAT WEED (*AGERATUM CONYZOIDES* L.) IN PLANTATION CROPS IN HILL ZONE OF KARNATAKA

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ABSTRACT

Ageratum conyzoides L. is an erect, herbaceous annual weed of tropical and subtropical region commonly called as billy goat weed. It interferes with growth and production of annual and perennial crops results in considerable yield loss. The weed thrives best in rich moist mineral soils with higher humidity and is often difficult to control. The reproductive biology of weed has an implication on controlling practices that minimize the populations on agricultural fields. The study was conducted to know the pattern of weed seed production and its relationship with growth characteristics. It was found that a single plant of *A. conyzoides* can able to produce an average of 4033 to 35000 seeds in a span of 28 to 54 seed rainy days which is highly influenced by biomass and inflorescence of the plant besides prevailing environment. The number of seeds per plant was highly influenced by plant height, biomass and number of inflorescence per plant. Per cent seed production was highest during seventh seed rain episode and lowest during first seed rain episode. The test weight was highest during initial stage of seed formation and was lowest during later stage of seed formation.

KEYWORDS: Growth, Seed Production Pattern, Seed Rain, Ageratum Conyzoides, Plantation Crops

INTRODUCTION

Ageratum conyzoides L. (Billy goat weed) is a common weed garden land, pastures and other damp and shady places. It is an erect softy hairy, annual herb with plant height 30 to 220 cm. The leaves are opposite, petiolate, ovate orenate and serrate with an average length of 7.5 cm. The heads are small homogenous in dense corymbs. The flowers are purple to white in colour and arranged in close terminal inflorescence. The fruit is an achene with an aristate pappus and is easily dispersed by wind (Kshatriya *et al*. 1994, in Ming 1999).The weed interferes with crop growth and development resulted in considerable loss of major staple crops of India (Kohli *et al*. 2006). In case of pastures due to its adulteration quality as deteriorated. Singh undated also reported that the reduction of yield and quality of crops viz. wheat, chickpea, rice, maize and sugarcane. The allelo chemicals produced from root and shoot system inhibited the germination of other crops. The fresh leaves and volatile oils of this weed also inhibited the seedling growth of various crops (Kong *et al*. 1999) including peanut, red root, amaranth, cucumber and rye grass (Kong Hu & Xu 2002). The negative impact of *A.Conyzoides* leaf extract and its residues on wheat growth and development was also observed by Singh *et al*. 2003, in Batish *et al*. 2009.

This weed is a problem for farmers, ecologists, locals, environmentalists and animals (Batish 2008). In this contest the management of this weed is a need of the hour. But for the management of this weed requires its biology should

be known. Therefore an experiment was conducted to study the seed production pattern of Billy goat weed in plantation crops in hilly zone of Karnataka.

MATERIAL AND METHODS

The study was conducted to know the biology of *Ageratum conyzoides* seed production potential under the canopy of plantation crops such as Coffee, Cardamom and Pepper at Zonal Agricultural Research Station (ZARS), Mudigere, Chikmagalur district which belongs to hilly zone (Agro-climatic zone-9) of Karnataka. The zone is characterized by high elevation, undulated and rolling topography with thick vegetative cover in slope land. The zone receives heavy rain fall of 2800 to 3500 mm per annum and located at $13^0$25'N latitude and $75^0$25'E longitude and at an elevation of 975.6 m above mean sea level. The monthly average sunshine hours was ranged from 6.10 to 10.27 hour in February, March, April and May. A minimum sunshine 0.43 to 0.90 hour was observed in August. The maximum and minimum mean temperatures recorded during the period of study were 32.04mm and 15.16 mm respectively. The average relative humidity (RH) during morning and evening hours was 80 to 88.58 percent and 14.93 to 83.48 percent respectively. The soils are generally red in colour with acidic pH and loamy in texture and rich in organic matter. Experimental site of ten square meter land area under the canopy of Coffee, Cardamom and Pepper plantation was used for collection of data. *A. conyzoides* plants were selected randomly in between crop rows were tagged in the marked area of the experimental site.

Growth Parameters

The plant height (cms) of the tagged plant was measured at the time of flowering from ground level to the top and average height per plant was obtained. The branches of *A.conyzoides* were numbered serially from base of the plant. Matured seeds were collected from the branches in each plant were pooled and calculated average number of seeds per plant. After the completion of seed rain episodes, the plant biomass was dried in oven and mean dry weight of each plant was calculated. Seed rain episode is the shattering of the seeds from different branches at a particular growth stage. Subsequent seed rain episodes takes at irregular interval of time. Hence it is coded as DAFSS (Days after first seed shattering). It will take maximum of 54 DAFSS for all the seed rains from a plant.

Seeds Collection

The total number of seeds of *A. conyzoides* were collected from all the seed rain episodes of the plant separately episode of the plant separately into the plastic bags and dried under shade and stored in the seed desiccators. The average number seeds per plant were calculated and obtained seed rain episodes required to collect all the seeds from each plant and recorded the number of days taken to complete all the seed rain episodes of each plant. Seed production potential was calculated as product of Number of seeds per seed rain episode and the total number of seed rain episodes per plant. The test weight (g) of seeds collected from different seed rain episodes of different branches in each plant.

Statistical Analysis

The data collected from the laboratory, pot culture and field experiments were analysed statistically by adopting the ANOVA technique described by Panse and Sukhatme, (1999). Further Duncan Multiple Range test was applied using M stat-C software. The percent values were first transformed into angular transformation (arcsine) values before analysis. Based on additive test the data was suitably transformed and ANOVA was carried out. The data were tested at five percent level for significance using student "t" test and non significant data were indicated by the letters NS and significant

difference at 5% level was represented as '*'.

RESULTS AND DISCUSSIONS

In Indian condition *A.conyzoides* starts bearing flowers from July to march as reported by Bathish, 2008. This weed has the potential to produce 40,000 to 94,772 seeds per plant. Out of these 50 percent of the seeds are going to germinate and also due to its extraordinary physiological plasticity enhanced the persistence of this weed for longer period in arabal fields. (Ekeleme *et al*.2005, Holm *et al*.1977 and PIER 2008).

The table-1 depicts the growth and seed yield parameters of *A.conyzoides*. Among the four randomly selected plants of *A.conyzoides* a highly significant variation in plant height (30 to 220cm),number of branches/plant (18 to 20), Biomass/plant (6 to 38g), seeds produced per plant (4000 to 35000), days taken to complete seed raining period (28 to 54), and average number of seed rain episodes ranged from 8-12. The time interval of seed production was extended maximum upto 54 days from first seed rain episode to last seed rain episode, in a total of 12 seed rain episode were obtained. The highest average number seeds produced by each plant were obtained 14044. It was indicated that the seedling ability of *A. conyzoides* increases as biomass increases.

Table 1: Relationship between Growth and Seed Yield Parameters in *A. Conyzoides*

Plant No.	Pl Ht. (cms)	Branch/Pl	DW (g)/pl	INFL/Pl	Seed Rain/pl	Seed /pl	Days taken to Complete all Seed Rains
P1	220	20	38	478	12	35346	52
P2	72	20	22	253	12	11758	54
P3	40	18	8	122	10	5039	23
P4	30	20	6	68	8	4033	28
Mean±σ	**90.5 88.17**	**19.5 1.00**	**18.5 14.82**	**230.25 182.52**	**10.5 1.91**	**14044 1460.48**	**39.5 14.00**

DW-Dry weight INFL-Inflorescence

The number of seeds per plant had significant and positive correlation with plant height(r=0.955*), Plant dry weight (r=0.978*) and number of inflorescence per plant (r=0.995*). Lutman, 2002 and Lutman et al., 2008 also observed the strong relationship between seed production and plant dry weight of *Senecio vulgari, S. media, Tripleurospermum inodorum* and *Sinopis arvensin* weed sps.

Table 2: Relationship between Growth and Seed Yield Parameters in *A. Conyzoides*

Characters	A	B	C	D	E	F	G
A	1	0.381	**0.955***	**0.972***	0.677	**0.999***	0.475
B		1	0.472	0.395	0.174	0.410	0.816
C			1	**0.995***	0.833	**0.965***	0.385
D				1	0.825	**0.978***	0.352
E					1	0.691	-0.142
F						1	0.483
G							1

(N=4) *Significance at 5% level

A: Plant Height (cms) **B:** Number of Branches/Plant C**:** Dry Weight (g)/plant
D: Inflorescence/Plant **E**: Number of seed Rain/plant **F**: Number of seeds /plant
G: Days taken to complete seed rain

The time interval between seed rain episodes and days taken to complete entire seed rains varies between and among the species. In case of *A.conyzoides* the time interval for seed production was extended upto 54 days from first seed rain episode. The seventh seed rain episode recorded the maximum seed production of 23 per cent where as the first seed rain episode recorded only 3 per cent (figure 1). This was due to its non-synchronomous variation in nutrient and moisture availability and environmental factors influencing the seed production.

The time interval for seed production was extended upto 54 days from first seed shattering to last seed rain episode, in total of 12 seed rain episodes. The maximum seed production was noticed during seventh seed rain episode (23%) and lowest of (3%) was observed in the beginning of seed shattering. It is gradually decreasing trend of seed production was observed after the peak (figure 1). This variation in seed production may be due to the changes in the availability of food resources and prevailing weather conditions.

The test weight varied significantly during seed rain episodes (0.086 to 0.167g). It was significantly higher during second seed rain episode and was being on par during first, third and seventh seed rain episodes as compared to others. The lowest test weight was recorded during twelfth seed rain episode. Seed mass varies considerably among and within species in different habitats and different stages of succession. In an individual plant seed mass decreased from base of the plant to distal position. This variation is mainly due to limited availability of parental resources such as nutrients and photosynthesis to the flowers formed at final stage of weed plant. Similar pattern of declining in seed mass towards plant distal end was observed in *Capsella bursa-pastoris* (Hurka and Benneweg, 1979*)*, *Cassia fasciculate* Michx. (Lee and Bazzaz, 1986), *Thlaspi arvense* L. (Matthies, 1990) and *Asphodelus albus* (Obeso, 1993) Further it is also evidenced by Susko and Lovett-Doust (2000) that in garlic mustard (*Alliaria petiolata*) a biennial herb.

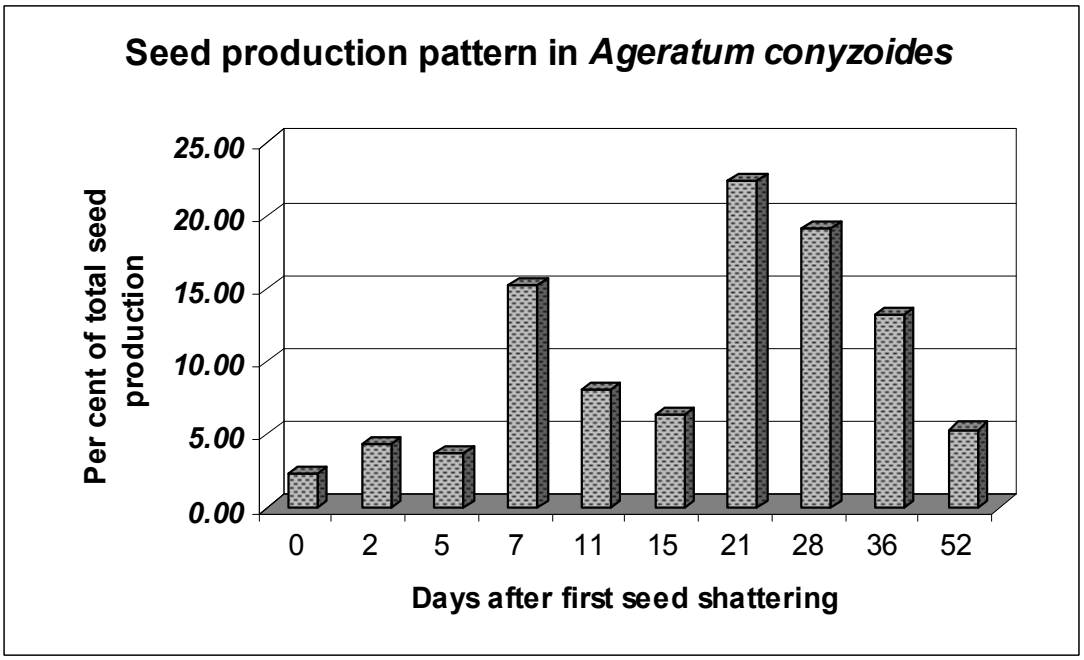

Figure 1: Pattern of Seed Production in Different Seed Rain Episodes in *A.Conyzoides*

Table 3: The Average Weight of 1000 Seeds in Different Branches in Different Seed Rain Episodes of *A. Conyzoides*

Seed Rain Episode	E1 (0*)	E2 (2)	E3 (5)	E4 (9)	E5 (13)	E6 (17)	E7 (22)	E8 (26)
Mean	0.163^{a}	0.167^{a}	0.154^{ab}	0.142^{abc}	0.125^{abc}	0.114^{abcd}	0.131^{abc}	0.101^{bcd}

Seed rain Episode	E9 (32)	E10 (36)	E11 (40)	E12 (54)	CD(P=0.05)
Mean	0.119^{abcd}	0.101^{bcd}	0.093^{cd}	0.086^{d}	0.038

*DAFSS-- (Days after First Seed Shattering)

CONCLUSIONS

Ageratum conyzoides is an annual weed having higher persistence in tropical and subtropical region is mainly due to its physiological plasticity. A strong positive correlation was observed for number of seeds per plant and plant height. The maximum seed production was observed during seventh seed rain episode and the highest test weight was observed at initial stage than later stage of seed shattering. These are the most important parameters on which the main concern has been needed to in controlling the weed menace in order to reduce the crop yield losses due to the weed.

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